REMARKS

Claims 16-17, 63-87, 89-103 and 131-132 are pending. Claims 16, 63, 79 and 131 have been amended by this response. Claims 1-15, 18-62, 88, 104-130, and 133-160 were canceled in a previous response.

The Examiner rejected claims 16-17 and 131-132 under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over either one of US Pub. 20030005958 ("Rocha-Alvarez"), USP 6843882 ("Janakiraman") or US Pub. 2003/0133854 ("Tabata").

The Examiner rejected claims 63-67, 71-75, 78-84, 87-93 and 96 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over WO 02/18672 ("Jurgensen WO").

The Examiner rejected claims 63-67, 71-75, 78-84, 87-93 and 96 under 35 U.S.C. 102(e) as being anticipated by US Pub. 2004/0003779 ("Jurgensen US Pub").

The Examiner rejected claims 63-70, 72, 75-83, and 92-96 under 35 U.S.C. 102(b) as being anticipated by USP 6113984 ("MacLeish").

The Examiner rejected claims 63-67, 71-75, 78-83, 92, 94 and 96-97 under 35 U.S.C. 102(e) as being anticipated by US Pub. 2003/0005886 ("Park").

The Examiner rejected claims 63-67, 71-75, 78-83, 92-93 and 96-99 under 35 U.S.C. 102(b) as being anticipated by USP 5334277 ("Nakamura").

The Examiner rejected claims 63, 97-99 and 102-103 under 35 U.S.C. 102(b) as being anticipated by US Pub. 2002/0054745 ("Van de Walle").

The Examiner rejected claim 16 under 35 U.S.C. 103(a) as being unpatentable over USP 4798166 ("Hirooka") in view of USP 5281295 ("Maeda").

The Examiner rejected claims 68-70 and 75-77 under 35 U.S.C. 103(a) as being unpatentable over Jurgensen WO or US Pub 2003/0221624.

The Examiner rejected claims 85-86 under 35 U.S.C. 103(a) as being unpatentable over (Jurgensen WO or US Pub 2003/0221624) in view of JP 62211914 ("Ikeda").

The Examiner rejected claims 97-103 under 35 U.S.C. 103(a) as being unpatentable over (Jurgensen WO or US Pub 2003/0221624) in view of Van de Walle.

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MACPHERSON KWOK CHEN & HEID LLP
18200 Von Karman
SUITE 725
IRVINE CA 92612
(949) 752-7040
FAX (408) 392-9262

The Examiner rejected claims 97-103 under 35 U.S.C. 103(a) as being unpatentable over (Jurgensen WO or US Pub 2003/0221624) in view of Van de Walle and further in view of Hirooka.

Rejection of Claims 16, 17, 131 and 132 Under 35 U.S.C. 102(e) or, in the alternative, under 35 U.S.C. 103(a) over Rocha-Alvarez, Janakiraman or Tabata

Independent claims 16 and 131 have been amended to recite "A method for chemical vapor deposition comprising . . . individually controlling amounts of components of the reactant gases directly provided to each of the chambers with gas flow controllers independently from each other."

The amendments to claims 16 and 131 find support at least at page 23, paragraphs [00117]-[00118] and Figure 10 of the specification as originally filed. No new matter has been added. It is clear from Figure 10 that substantially the same gas mixture is being provided by common reactant gas supply or inlet system 960 to each chamber directly and in a controlled and independent manner via gas flow controllers 902. That is, gas flow controllers 902 facilitate independent control of the amount of reaction gas provided to each chamber as well as simultaneous provision of gas to each chamber.

Rocha-Alvarez

By way of contrast, Rocha-Alvarez discloses a "gas flow measuring apparatus (GFM) 182 . . . [that] includes a flow output 185 and one or more flow measurement signal outputs 155 adapted to provide flow measurement signals . . . indicative of the amount of flow through gas delivery line 139. Further, the GFD 180 includes a gas flow control apparatus (GFC) 184 . . . [that] comprises . . . a flow control input 161 coupled to and responsive to the flow measurement signal output 155 from the GFM 182 (emphasis added)." Rocha-Alvarez, ¶ [0034]. This structure **teaches away** from providing reactant gases to each chamber in an independent manner. Rocha-Alvarez explicitly discloses that the flow through GFC 184 is controlled by the flow through GFM 182, as stated in,

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18200 Von Karman
SUITE 725
IRVINE CA 92612
(949) 752-7040
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for example, ¶ [0034]: "as the gas flow increases through the GFM 182, the flow measurement signal from the signal output 155 may increase in voltage or current. The gain of the flow control input 161 may be set such that a minimum voltage from the signal output 155 corresponds to a minimum flow and a maximum flow measurement signal output 155 corresponds to a maximum flow through the GFC 184." Moreover, an object of Rocha-Alvarez is to provide a method and apparatus for fluid flow control wherein "the gas flow from a first supply to a first processing region is used to control the gas flow of a second supply to a second processing region" (Abstract). This is contrary to having "individually controlling amounts of components of the reactant gases directly provided to each of the chambers with gas flow controllers <u>independently from each other</u>," as recited in claims 16 and 131 of the present application. Further, it is respectfully submitted that claims 16 and 131 recite a "method for chemical vapor deposition," which is a much different application than a "water supply in homes in a community" as suggested by the Examiner in the Office Action at page 9.

<u>Janakiraman</u>

Janakiraman fails to disclose, at least, "A method for chemical vapor deposition comprising . . . individually controlling amounts of components of the reactant gases <u>directly</u> provided to each of the chambers with gas flow controllers <u>independently from each other.</u>" Instead, Janakiraman discloses that "the inlet gas flows from the gas lines 158A, 158B each pass through respective mixing block 160A, 160B, blocker plate 162A, 162B, and faceplate 164A, 164B into the interior of the corresponding chamber 152A, 152B." Janakiraman, col. 6, lines 59-62. Furthermore, a connecting line 178 is provided between the two mixing blocks 160A, 160B to permit flow therebetween. "To achieve equal flow division between the two chambers 152A, 152B, the total impedance along the first branch through the first chamber 152A needs to match the total impedance along the second branch through the second chamber 152B." Col. 7, lines 21-24. Janakiraman discloses that to "compensate for manufacturing tolerances in components between chambers and for other differences between the chambers, gas flows through the chambers are controlled to achieve substantially identical process results in the chambers.

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(949) 752-7040
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This is done by manipulating the flow impedances along the flow paths through the chambers." Janakiraman, col. 2, lines 15-21. This indicates that the flow rate for each chamber is dependent (not independent) on the other chambers to achieve identical process results in the plurality of chambers. Furthermore, Janakiraman fails to disclose <u>directly</u> providing reactant gases to each chamber as it discloses using mixing blocks 180A, 180B, blocker plates 182A, 182B, faceplates 184A, 184B (see Figure 7) and their corresponding impedances. This is a completely different structure than the present application as claimed.

<u>Tabata</u>

Tabata also fails to disclose, at least, "A method for chemical vapor deposition comprising . . . individually controlling amounts of components of the reactant gases <u>directly</u> provided to each of the chambers with gas flow controllers <u>independently from each other.</u>" Tabata discloses using a "gas discharge pipe 8 having the APC 81 as the gas discharge passage . . . provided in parallel with the gas supply passages 401 to 403." ¶[0068]. This is so that "Upon controlling the pressure in the gas discharge pipe 8 communicated with the conduits 401 to 403 by operating the APC81, . . . , the pressure in the conduits 401 to 403 can be suitably controlled on the side of the ozone generator 31." ¶[0070]. That is, Tabata discloses that, in addition to MFCs 411 to 413, the APC 81 is needed in the gas discharge pipe 8 to control the pressure in the conduits 401 to 403. This is a completely different structure from the present application as claimed.

It is respectfully submitted that none of the cited references, taken either alone or in combination with one another, either disclose or make obvious a method for chemical vapor deposition comprising "individually controlling amounts of components of the reactant gases <u>directly</u> provided to each of the chambers with gas flow controllers <u>independently from each other</u>," as recited in amended claims 16 and 131. It is therefore respectfully submitted that independent claims 16 and 131, as well as claims 17 and 132 that depend therefrom, respectively, are in condition for allowance.

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(949) 752-7040
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Rejection of Claims 63-67, 71-75, 78-84, 87-93 and 96 Under 35 U.S.C. 102(b), or in the alternative, under 35 U.S.C. 103 (a) as obvious over Jurgensen WO or Jurgensen US Pub.

Independent claim 63 has been amended to recite "providing a chamber containing a wafer carrier wherein the wafer carrier and the chamber cooperate to define a generally flat, continuous and unobstructed flow channel; rotating the wafer carrier with a spindle; effecting generally laminar flow of gas through the flow channel intermediate a portion of the chamber and the wafer carrier; and enhancing laminar flow from a reaction gas inlet formed generally centrally in the chamber to a ring diffuser disposed proximate a periphery of the wafer carrier and a ring seal, wherein the ring seal is disposed around the rotating wafer carrier to bridge the flow channel, and wherein the ring diffuser is comprised of at least one of SiC coated graphite, SiC quartz, or molybdenum."

Support for the amendments to claim 63 may be found in the specification of the present application at least at, for example, paragraph [0098]-[00100] and Figures 5, 7 and 8. No new matter has been added. The embodiments of Figures 5, 7 and 8 clearly show a flat, continuous and unobstructed flow channel as well as a ring seal 132 around the rotating wafer carrier 116 to bridge the flow channel 130 of the exhaust gas flow such that flow resistance is reduced and laminar flow is substantially enhanced. Furthermore, the embodiments of Figures 5, 7 and 8 illustrate a ring shaped diffuser 133 (better shown on Figures 6A and 6B) effectively making almost the entire periphery of the reactor, proximate the periphery of the wafer carrier 116 and the ring seal 132, one generally continuous gas outlet port.

Jurgensen WO and/or Jurgensen US Pub fail to disclose, at least, "providing a chamber containing a wafer carrier wherein the wafer carrier and the chamber cooperate to define a generally flat, continuous and unobstructed flow channel" as recited in claim 63. Instead, Jurgensen WO and Jurgensen US Pub disclose in Figure 1 that the gas admission element 6 is an overall two-part configuration having a core, which forms a section 49 which projects into the process chamber 1 and is frustoconical in shape. That is, Jurgensen WO fails to disclose a continuous or unobstructed flow channel between the

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carrier plate 3 and the top of the chamber as the section 49 projects into the process chamber 1.

The dependent claims all depend upon amended independent claim 63. Thus, all of the dependent claims are believed to be allowable.

Rejection of Claims 63-70, 72, 75-83, and 92-96 Under 35 U.S.C. 102(b) as being anticipated by MacLeish.

MacLeish fails to disclose, at least, "enhancing laminar flow from a reaction gas inlet formed generally centrally in the chamber to a ring diffuser disposed proximate a periphery of the wafer carrier and a ring seal, wherein the ring seal is disposed around the rotating wafer carrier to bridge the flow channel, and wherein the ring diffuser is comprised of at least one of SiC coated graphite, SiC quartz, or molybdenum," as recited in claim 63.

MacLeish discloses "a bottom plate 107 which is supported on a periphery thereof by body 102" (col. 13, lines 49-50), and a spacing 130 so that during "processing, hydrogen gas or any other suitable gas is forced through spacing 130 into reaction chamber 128" (col. 14, lines 55-59). MacLeish completely fails to disclose a ring diffuser disposed proximate a periphery of the wafer carrier and a ring seal as claimed in the present application.

The dependent claims all depend upon amended independent claim 63. Thus, all of the dependent claims are believed to be allowable.

Rejection of Claims 63-67, 71-75, 78-83, 92, 94 and 96-97 Under 35 U.S.C. 102(e) as being anticipated by Park.

Park fails to disclose, at least, "providing a chamber containing a wafer carrier wherein the wafer carrier and the chamber cooperate to define a generally flat, continuous and unobstructed flow channel; . . . enhancing laminar flow from a reaction gas inlet formed generally centrally in the chamber to a ring diffuser disposed proximate a periphery of the wafer carrier and a ring seal, wherein the ring seal is disposed around the rotating wafer carrier to bridge the flow channel, and wherein the ring diffuser is

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comprised of at least one of SiC coated graphite, SiC quartz, or molybdenum," as recited in claim 63.

Park discloses that an "upper plate 12 of the reactor housing 10 serves to guide a laminar flow of the reaction gas C, cooperating with an upper surface 22 . . ." Then, Park discloses that a reaction gas exhaust 50 and "an exhausting opening 55 through which the reaction gas C remaining after contribution to the semiconductor film growth is exhausted to the outside is formed through a flank portion of the reactor housing 10 and a passage through which the reaction gas C flows is formed between a lateral surface of the susceptor 20 and an inner surface of the flank portion of the reactor housing 10." Park, ¶ [0015]. That is, the positions of the reaction gas exhaust 50 and the exhausting opening 55 shown in Figure 1 as being at a lower portion of the reactor housing 10 and below the susceptor 20, indicate that the laminar flow is not flat, as claimed in the present application.

Furthermore, Park completely fails to disclose a ring seal or a ring diffuser disposed proximate a periphery of the wafer carrier and the ring seal to enhance laminar flow, as claimed in the present application.

The dependent claims all depend upon amended independent claim 63. Thus, all of the dependent claims are believed to be allowable.

<u>Rejection of Claims 63-67, 71-75, 78-83, 92-93 and 96-99 Under 35 U.S.C. 102(b) as being anticipated by Nakamura.</u>

Nakamura fails to disclose, at least, "providing a chamber containing a wafer carrier wherein the wafer carrier and the chamber cooperate to define a generally <u>flat, continuous and unobstructed flow channel;</u> . . . enhancing laminar flow from a reaction gas inlet formed generally centrally in the chamber to <u>a ring diffuser disposed proximate a periphery of the wafer carrier and a ring seal, wherein the ring seal is disposed around the rotating wafer carrier to bridge the flow channel, and</u> wherein the ring diffuser is comprised of at least one of SiC coated graphite, SiC quartz, or molybdenum," as recited in claim 63.

Nakamura discloses "a chamber 6, a susceptor 4, a heater 7, a reaction gas blow tube 2 an infrared intensity detector 9, and a sub blow tube 3," Nakamura, col. 7, lines

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16-19, then, Nakamura discloses an "exhaust port 8 for exhausting gases in the chamber," col. 7, lines 25-26, which is shown in Figure 7 to be positioned at a lower portion of the chamber 6 and below the susceptor 4. This positioning teaches away from having a flat, unobstructed laminar flow. Also, the chamber 6 in Nakamura has structures (e.g. sub blow tube 3) that extend thereinto in a manner that tends to disrupt laminar flow as described and claimed in the present application. As such, it is respectfully submitted that this reference teaches away from the use of a chamber wherein a generally, flat, continuous and unobstructed laminar flow is effected, as claimed in the present application.

Further, Nakamura completely fails to disclose a ring seal or a ring diffuser disposed proximate a periphery of the wafer carrier and the ring seal to enhance laminar flow, as claimed in the present application.

The dependent claims all depend upon amended independent claim 63. Thus, all of the dependent claims are believed to be allowable.

Rejection of Claims 63, 97-99 and 102-103 Under 35 U.S.C. 102(b) as being anticipated by Van de Walle.

Van de Walle fails to disclose "providing a chamber containing a wafer carrier wherein the wafer carrier and the chamber cooperate to define a generally flat, continuous and unobstructed flow channel; . . . enhancing laminar flow from a reaction gas inlet formed generally centrally in the chamber to a ring diffuser disposed proximate a periphery of the wafer carrier and a ring seal, wherein the ring seal is disposed around the rotating wafer carrier to bridge the flow channel, and wherein the ring diffuser is comprised of at least one of SiC coated graphite, SiC quartz, or molybdenum," as recited in claim 63.

Instead, Van de Walle discloses a "quartz reactor cell 1700" having a geometry that "is vertical flow with reactant gases being injected at the top of the reactor through line 1730, which is about 25 cm above sapphire wafer surface 1750. . . . Saphire substrate wafer 150 sits on rotating . . . susceptor 1760." Van de Walle, ¶ [0049]. That is, Van de Walle discloses, as shown in Figure 17, that line 1730 projects into the quartz

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reactor cell 1700 such that there is not a continuous or unobstructed flow channel between susceptor 1760 and the top of quartz reactor cell 1700. Thus, Van de Walle teaches chambers having structures that extend thereinto in a manner that tends to disrupt laminar flow as described and claimed in the present application. As such, it is respectfully submitted that this reference teaches away from the use of a chamber wherein the distance between the wafer carrier and the portion of the chamber is small enough to effect a generally, flat, continuous and unobstructed laminar flow, as claimed in the present application.

Furthermore, Van de Walle completely fails to disclose a ring diffuser to enhance laminar flow, as claimed in the present application.

The dependent claims all depend upon amended independent claim 63. Thus, all of the dependent claims are believed to be allowable.

Rejection of Claim 16 Under 35 U.S.C. 103(a) as being unpatentable over Hirooka in view of Maeda.

Hirooka and Maeda, alone or in combination, fail to disclose, teach or suggest a "method for chemical vapor deposition comprising supplying a plurality of chambers with reactant gases from a common gas supply and individually controlling amounts of components of the reactant gases directly provided to each of the chambers with gas flow controllers independently from each other," as recited in claim 16.

The Examiner stated that "Hirooka et al do not explicitly disclose flow controllers for each chamber." Office Action, page 6. The Examiner then cites Maeda stating that "Maeda et al disclose one common gas supply distributed to plurality of process stations through flow controllers."

It is respectfully submitted that, unlike the present application, Maeda discloses that "the exhaust pipes 21a to 21e are connected to branch pipes 19a to 19e in parallel with the outlet pipes 20a to 20e, respectively. The outlet pipes 20a to 20e and the exhaust pipes 21a to 21e are provided with the needle valves 25a to 25e and the needle valves 26a to 26e, respectively. Accordingly, it is possible to control the gas flows through the outlet pipes 20a to 20e, including the gas dispersing devices 27a to 27e, to be almost equal to

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the gas flows through the exhaust pipes 21a to 21e, respectively." Maeda, col. 4 lines 20-29. Thus, Maeda uses switching valves for switching the flow of process gas between the outlet pipes and the exhaust pipes through first and second flow rate controllers so that it is possible to almost equalize the gas flows through the outlet pipes and processing stations with the gas flows through the exhaust pipes. This is different than the present application as claimed, which does not describe switching valves between outlet pipes and exhaust pipes through first and second flow rate controllers. Accordingly, it is respectfully requested that the rejection of claim 16 under 35 U.S.C. 103(a) over Hirooka in view of Maeda be withdrawn.

For the same reasons discussed above with respect to independent claim 63 from which claims 68-70, 75-77, 85-86, and 97-103 depend, it is respectfully requested that the rejections of dependent claims 68-70, 75-77, 85-86, and 97-103 be withdraw on the basis of dependency. Furthermore, the cited references, Jurgensen, Ikeda, Van de Walle and Hirooka, alone or in combination, fail to disclose, teach or suggest the limitations of the independent claim.

<u>General</u>

It is respectfully submitted that none of the cited references, taken either alone or in combination with one another, either disclose or make obvious a method for chemical vapor deposition comprising "individually controlling amounts of components of the reactant gases <u>directly</u> provided to each of the chambers with gas flow controllers <u>independently from each other</u>," as recited in amended claims 16 and 131.

Moreover, it is respectfully submitted that none of the cited references, taken either alone or in combination with one another, either disclose or make obvious a method for chemical vapor deposition comprising "providing a chamber containing a wafer carrier wherein the wafer carrier and the chamber cooperate to define a generally <u>flat, continuous and unobstructed flow channel;</u> . . . effecting generally laminar flow of gas through the flow channel intermediate a portion of the chamber and the wafer carrier; and enhancing laminar flow from a reaction gas inlet formed generally centrally in the chamber to <u>a ring diffuser disposed proximate a periphery of the wafer carrier and a ring</u>

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seal, wherein the ring seal is disposed around the rotating wafer carrier to bridge the flow channel, and wherein the ring diffuser is comprised of at least one of SiC coated graphite, SiC quartz, or molybdenum," as recited in amended claim 63.

Applicant respectfully submits that the claims are allowable. One advantage of the present disclosure is the ability to scale up production via the addition of more chambers to an existing gas inlet and outlet system. More particularly, by using multiple chambers, the claimed invention eliminates the need for a larger size chamber, which is especially hard to use for GaN material growth that requires high temperature and high flow of corrosive ammonia gas. When using larger sized chambers for increased throughput in a CVD system, the process and hardware designs need to be re-establish every time there is a size change. The development time is usually very long, several years. The history of GaN reactor size tells us it took about eight years for it to evolve from six wafers to twenty-one wafers throughput due to the complex process development associated with each size change. According to the claimed invention, the process does not change since the chamber size does not change. The scale up is almost unlimited. Each chamber is completely isolated without inter-communication and is independently controlled. Thus, the present disclosure provides substantial advantages over the prior art.

Furthermore, as described in the specification of the present application, gas flow resistance may be reduced and a higher degree of laminar flow through the chamber may be obtained with a more direct (and thus less contorted) and unobstructed route for a less turbulent flow.

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18200 Von Karman
SUITE 725
IRVINE CA 92612
(949) 752-7040
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CONCLUSION

It is respectfully submitted that all of the pending claims are in condition for immediate allowance. Reconsideration and an early allowance are therefore respectfully requested.

If the Examiner has any questions or concerns, a telephone call to the undersigned at (949) 752-7040 is welcomed and encouraged.

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Annie McNally

Dated: August 22, 2008

Respectfully submitted,

Alma P. Levy

Alma P. Levy
Attorney for Applicants
Reg. No. 43,751

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MACPHERSON KWOK CHEN & HEID LLP
18200 Von Karman
SUITE 725
IRVINE CA 92612
(949) 752-7040
FAX (408) 392-9262